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Request for grant of a patent

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1. Your reference
5293201/PT

15 JAN 1999

2. Patent Application Number
9900968.0

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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Patents ADP number *(if known)* 7584766001

If the applicant is a corporate body, give the country/state of its incorporation

Country: **United Kingdom**
State:

4. Title of the invention

Load Sensing System

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Patents ADP number 1826001

6. Priority details

Country	Priority application number	Date of filing

Load Sensing System

The present invention relates to braking systems for vehicles, and is particularly concerned with braking systems for load-carrying vehicles, most particularly light commercial vehicles.

Commercial vehicles have for many years been fitted with servo braking systems which apply brake fluid, which may be a hydraulic fluid or air, to brake actuator cylinders in response to control inputs from the vehicle driver. Pressure of the driver's foot on a brake pedal controls the flow of brake fluid to operate the brake actuator cylinders and apply brake shoes or pads to the vehicle wheel hubs or brake discs, respectively. The fluid is provided to the actuator cylinder from a high-pressure source via a servo device. By this means, the force applied by the driver to the pedal is amplified to the levels necessary to arrest the movement of a heavy vehicle.

In commercial vehicles, it is desirable for the vehicle to be able to carry a large payload in proportion to the unladen weight of the vehicle, and thus there is great variation between the unladen and fully laden weights of such vehicles. When the vehicle is unladen, deceleration can be achieved satisfactorily with relatively low fluid pressures in the brake actuator cylinders. As the total weight of the vehicle

progressively reduces the "ride height" of the vehicle as it is more heavily loaded, and acts as an indicator of the weight of the vehicle.

The operation of the load sensing valve is to provide a strong throttling action to reduce the flow of brake fluid to the brake actuator cylinders when the vehicle is lightly loaded, and when the vehicle is heavily loaded to provide little or no throttling action and allow brake fluid to flow unimpeded to the brake actuator cylinders when the driver applies pedal pressure. The actual braking effect generated by the brake actuator cylinders thus increases as the vehicle is more heavily loaded. Each vehicle has a design relationship between the gross weight and the braking amplification factor, calling for a predetermined variation of the degree of throttling provided by the load sensing valve over the range of vehicle weight from unladen to maximum gross weight. Typically, the load sensing valve will reduce the brake fluid pressure by some 1500psi when the vehicle is unladen, and will allow free flow when the vehicle is at its maximum gross weight.

In recent years the use of "air suspension" has become widespread in heavy goods vehicles. However, in applying this technology to light goods vehicles, vans or the like a significant difficulty has emerged as regards the variation of braking performance with vehicle

vehicle's gross weight in a control arrangement for the braking system.

An objective of the present invention is to provide a braking system for a vehicle with air suspension, wherein the brake servo amplification factor increases in proportion to an increase of the gross vehicle weight.

Another objective of the invention is to provide a braking system for a vehicle with air suspension, wherein the braking performance varies as a function of the gross vehicle weight throughout a predetermined weight range.

A further objective is to provide a load sensing arrangement for a vehicle with air suspension, operable to control the braking system of the vehicle in accordance with the gross vehicle weight.

A yet further objective of the invention is to provide a combined air suspension and braking system for a vehicle, whereby a substantially constant ride height may be maintained and the braking effect varied in accordance with the gross vehicle weight.

In accordance with a first aspect of the invention, there is provided a vehicle having a body suspended on one or more axles by means of gas-filled bags, the vehicle being provided with means to vary the pressure within the bags to control the spacing between the body and the axle or axles and a braking system supplying a brake fluid to braking actuators operable to brake the vehicle's wheels, and further comprising a load sensing

an electrical output signal corresponding to the suspension pressure, and the variable throttling valve is electrically controllable to vary the flow of brake fluid to a brake actuator, and a control circuit varies the throttling effect of the throttling valve in dependence on the output signal from the pressure sensor. It is further foreseen that the suspension and braking systems may be interlinked by an electrical or electronic control means, by providing sensors giving electrical output signals relating to ride height to control the supply of air to the suspension units, a detector to give an electrical output corresponding to suspension unit pressure, and an electrically controllable throttling valve to vary the flow of brake fluid to a brake actuator, the control means providing control signals to the throttling valve in dependence on the sensed suspension unit pressure.

Embodiments of the invention will now be described in detail with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view of an air suspension system and associated braking system according to a first embodiment;

Figures 2A and 2B are a schematic views of the load sensing valve of the suspension and braking system of Figure 1 when the vehicle is lightly loaded and heavily loaded, respectively;

and lowers the vehicle body from its datum position, the ride height sensor is moved to its first control position and air is admitted to the air bags to reinflate them until the datum height is regained.

With a decrease in load, the air bags 4 expand and raise the vehicle body above its datum position. The ride height sensor is then moved to its third control position and air is vented from the air bags to deflate them until the vehicle body returns to datum height.

The vehicle braking system comprises a brake pedal 10, linked to a master cylinder 11 to provide a brake pressure input to a servo 12. Servo 12 increases the brake pressure and supplies the increased pressure to load sensing valve 13. Valve 13 throttles the brake fluid, and controls its passage to brake actuator cylinder 14. When fluid is supplied to the actuator cylinder 14, brake shoes 15 expand to contact brake drum 16 and slow the vehicle. While an expanding shoe drum brake has been shown schematically in the Figure, it will be understood that any brake mechanism operated by fluid pressure may be used. Likewise it is to be understood that the fluid pressure may be transmitted by hydraulic fluid or other liquid, or by a compressed gas such as air.

The load sensing valve is shown schematically in Figures 2A and 2B, and comprises a valve body 20 having an inlet 21 and an outlet 22 for brake fluid. An

position shown in Figure 2A when the vehicle is lightly loaded. An increase in vehicle weight causes the vehicle body to drop, and the ride height sensor 3 operates to provide compressed air to the air bags 4 to lift the body back to its datum position. The pressure within the air bags 4 is thus increased, and this increased pressure is transmitted via duct 28 to the actuator 26, increasing its force. The increased force of actuator 26 overcomes the resistance of actuator 27, and swinging arm 25 moves to a new position (Figure 2B) in which the throttling element 24 is retracted from the passage 23 to reduce the throttling effect of the load sensing valve.

Similarly, as the vehicle weight is reduced, the ride height sensor 3 causes a pressure drop in the suspension air bags 4, and thus also in actuator 26, allowing actuator 27 to move the swinging arm 25 clockwise as seen in Figures 2A and 2B to increase the throttling effect of the load sensing valve.

The second actuator is a fluid actuator in the embodiment shown, but in alternative embodiments may be a resilient element such as a tension or compression spring, or a torsion spring operating on the swinging arm pivot. The spring may have a constant or a variable rate, i.e. the spring force may vary linearly or non-linearly with spring length.

In the embodiment shown in Figure 3, the fluid communication via duct 28 between the braking and

by the driver using an input device such as a keyboard 32. On the basis of the comparison, control circuit 31 provides a control signal to the ride height valve 33 either to admit air to the air bags 4, or vent air therefrom, to bring the sensed ride height to the desired ride height.

A pressure transducer 34 then senses the pressure in the air bags 4, and provides an output signal to the control circuit 31 corresponding to the sensed pressure. This output is also indicative of the vehicle weight when the vehicle is at the desired ride height, since the ride height adjustment raises or lowers the pressure in accordance with the vehicle weight.

On the basis of the sensed pressure, control circuit 31 provides control signals to an electromechanical valve 35 in the braking circuit to vary its throttling effect. The valve 35 acts in the same way as the load sensing valve 13 of the embodiment shown in Figure 1. The control circuit may include a look-up table 40a in memory 40 correlating values of sensed air bag pressure at the desired ride height with required positions for the throttle valve.

In an alternative embodiment, a conventional load sensing valve may be used, with an electromechanical actuator, such as a linear motor or a stepper motor and gearing, controlled by the control circuit 31 to position the swinging arm of the load sensing valve at the

ride height incrementally, for example in 10mm steps, to match a loading dock height and the vehicle load bed height.

throttling element approaches its second position.

3. A vehicle according to claim 2, wherein the first actuating means is a fluid actuator to which the pressure of the gas-filled suspension units is communicated.

4. A vehicle according to claim 2 or claim 3, wherein the first actuating means is an air bag.

5. A vehicle according to any of claims 2 to 4, wherein the second actuating means is a fluid actuator supplied with a controlled pressure.

6. A vehicle according to any of claims 2 to 5, wherein the second actuating means is an air bag.

7. A vehicle according to any of claims 2 to 4, wherein the second actuator is a resilient element.

8. A vehicle according to claim 7 wherein the resilient element is a spring.

9. A vehicle according to claim 1, wherein the load sensing valve includes a movable throttling element having a first position wherein a maximum throttling effect is exerted, and a second position wherein a minimum throttling effect is exerted, and further

vehicle having a vehicle body supported on an axle by an air suspension unit, the load sensing system comprising a sensor for detecting the pressure in the air suspension unit, a variable throttling valve operable to control the flow of brake fluid to a brake actuator, and control means to vary the throttling effect of the throttling valve in dependence on the output of the pressure sensor.

15. A load sensing system according to claim 14, wherein the variable throttling valve comprises a valve element movable between closed and open positions to vary the throttling effect, and a fluid pressure actuator responsive to the pressure in the suspension unit and operable to urge the valve element toward its open position against a restoring force.

16. A load sensing system according to claim 15, wherein the restoring force is provided by a second fluid pressure actuator.

17. A load sensing system according to claim 16, wherein the second fluid pressure actuator is supplied with fluid at a regulated pressure.

18. A load sensing system according to claim 15, wherein the restoring force is provided by a resilient element.

Abstract of the disclosure

Load Sensing System

There is described a vehicle having a body suspended on one or more axles by means of gas-filled suspension units (4), the vehicle being provided with means (3) to vary the pressure within the suspension units to control the spacing between the body and the axle or axles and a braking system supplying a brake fluid to braking actuators (14) operable to brake the vehicle's wheels, and further comprising a load sensing valve (13) operable to apply a variable throttling effect to impede the flow of brake fluid to the braking actuators, characterised in that the throttling effect of the load sensing valve is varied by a control means (26, 28) including a sensor responsive to the pressure within the gas-filled suspension units.

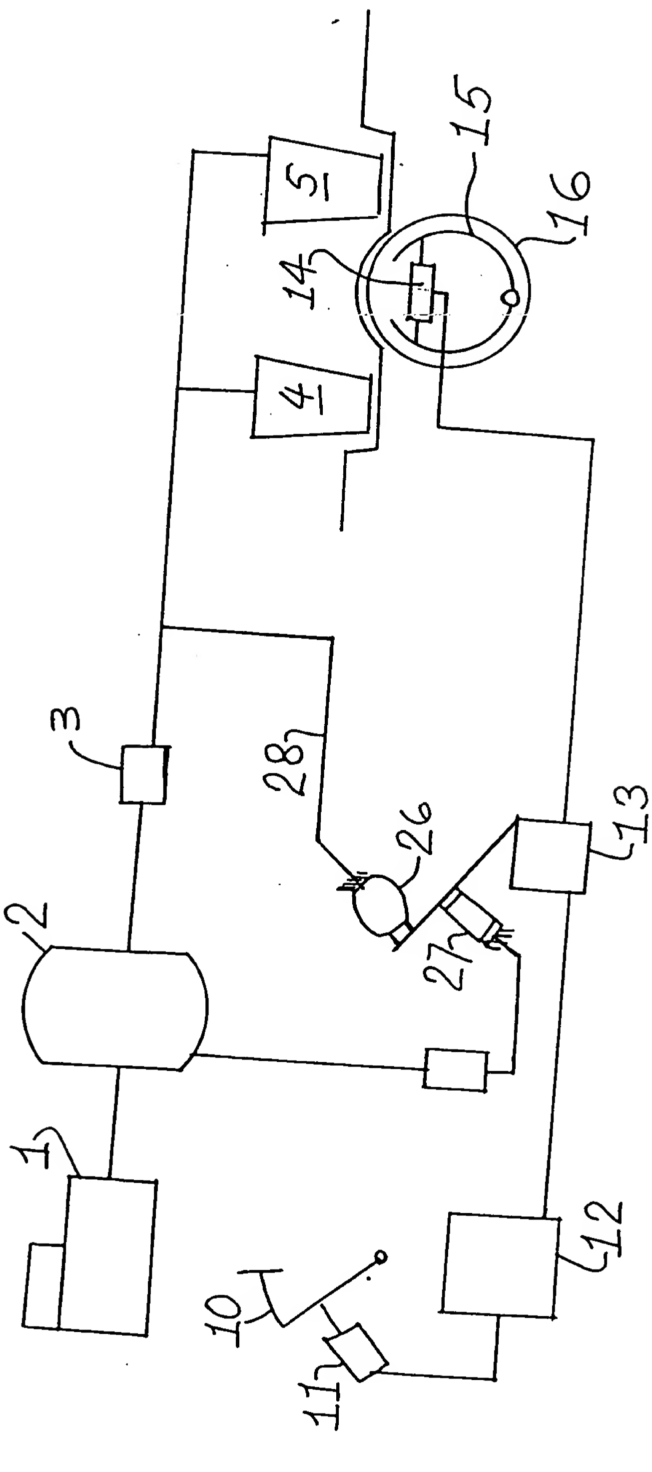

FIG 1

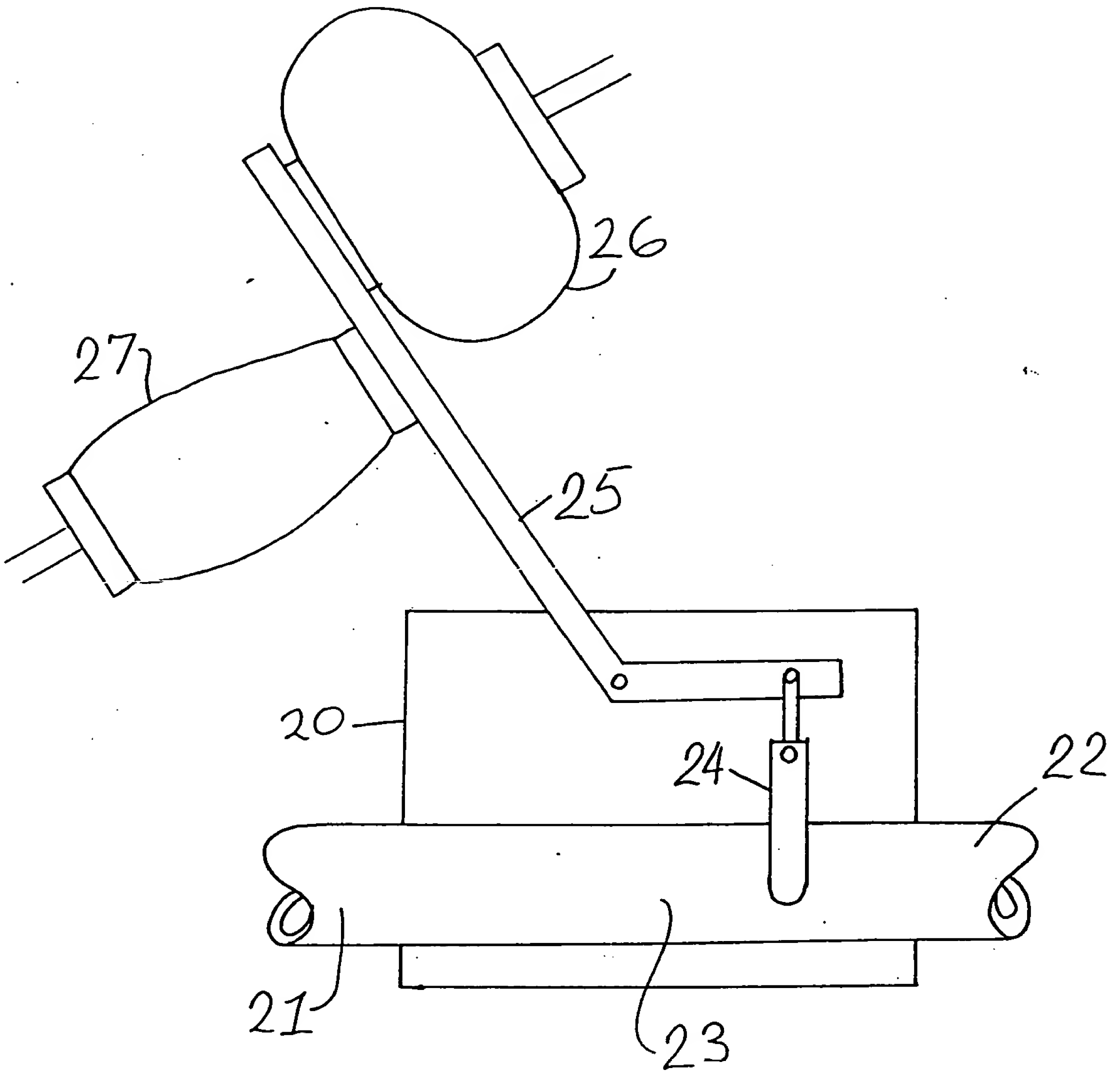

FIG 2A

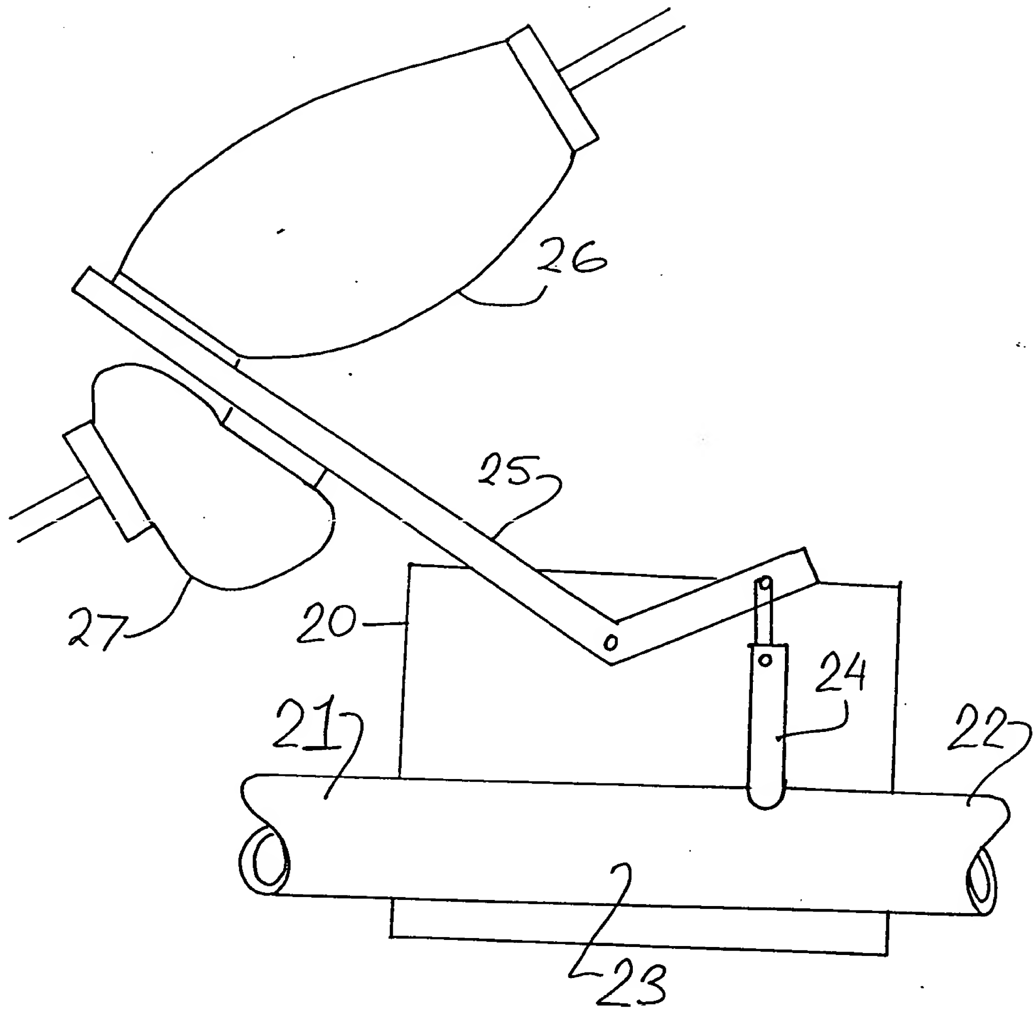

FIG 2B

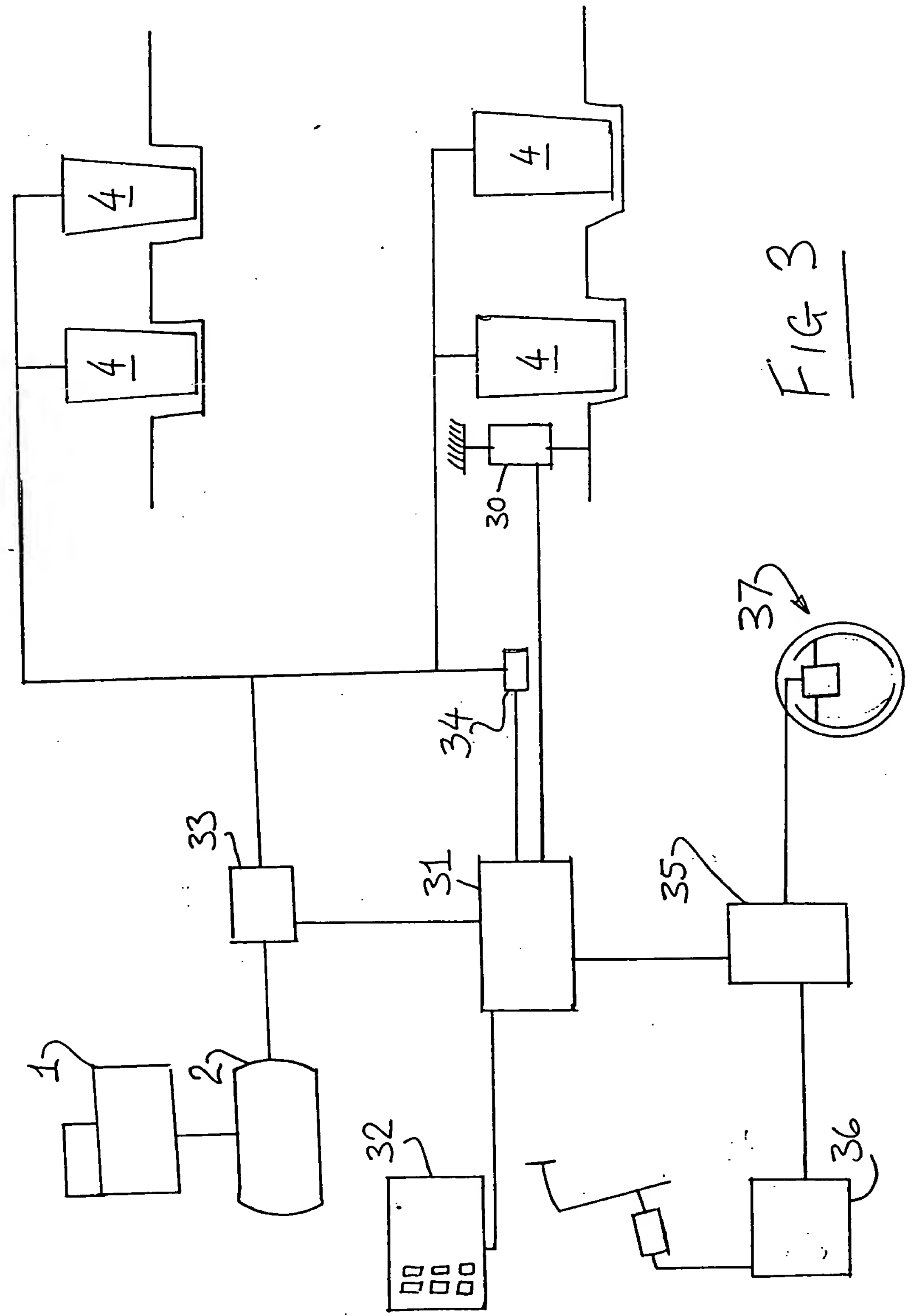

FIG 3

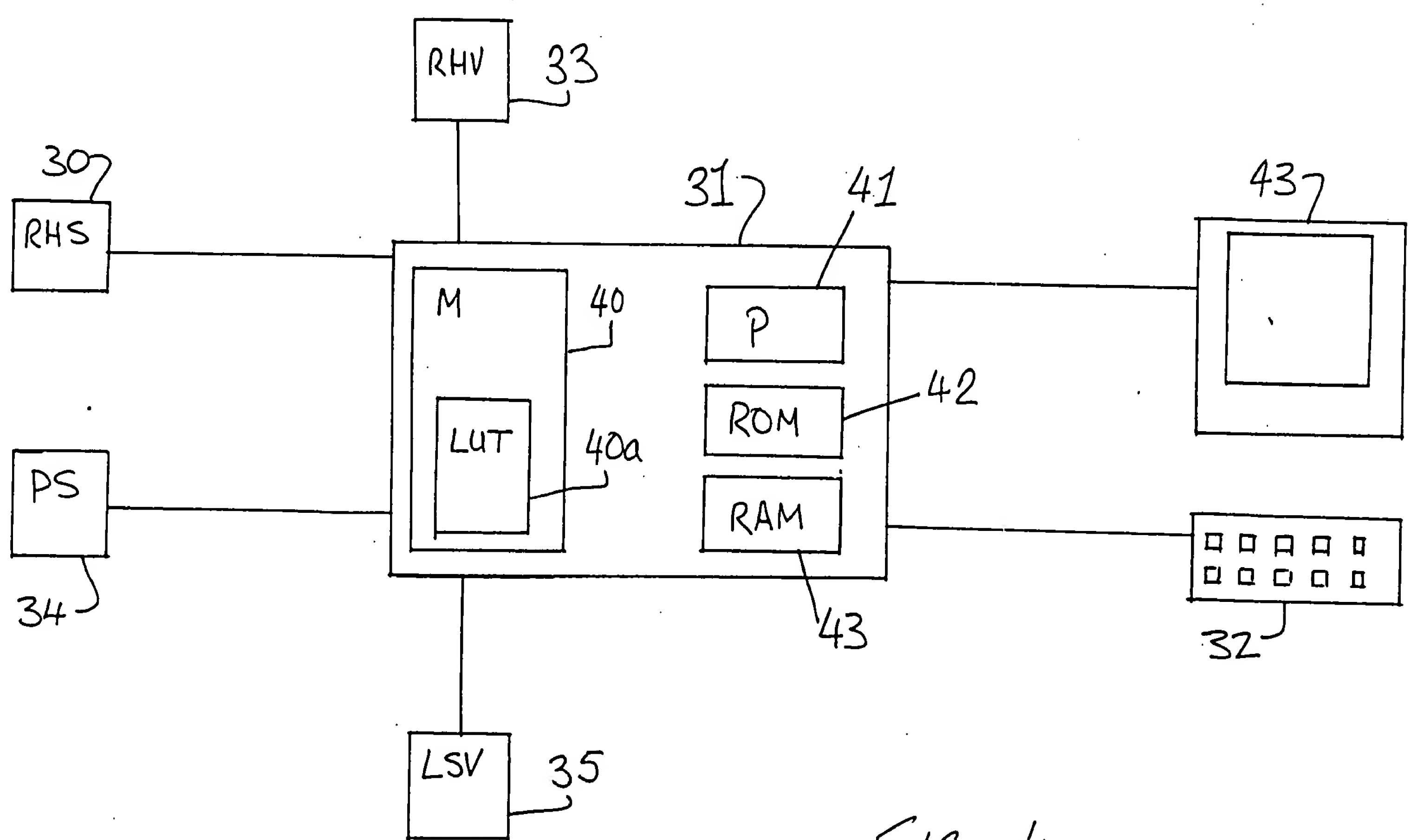

FIG 4